Presented at
2016 ADEM
Groundwater Conference
June 8, 2016

LONG-TERM MANAGEMENT of MNA for a HYDROCARBON PLUME - LESSONS LEARNED

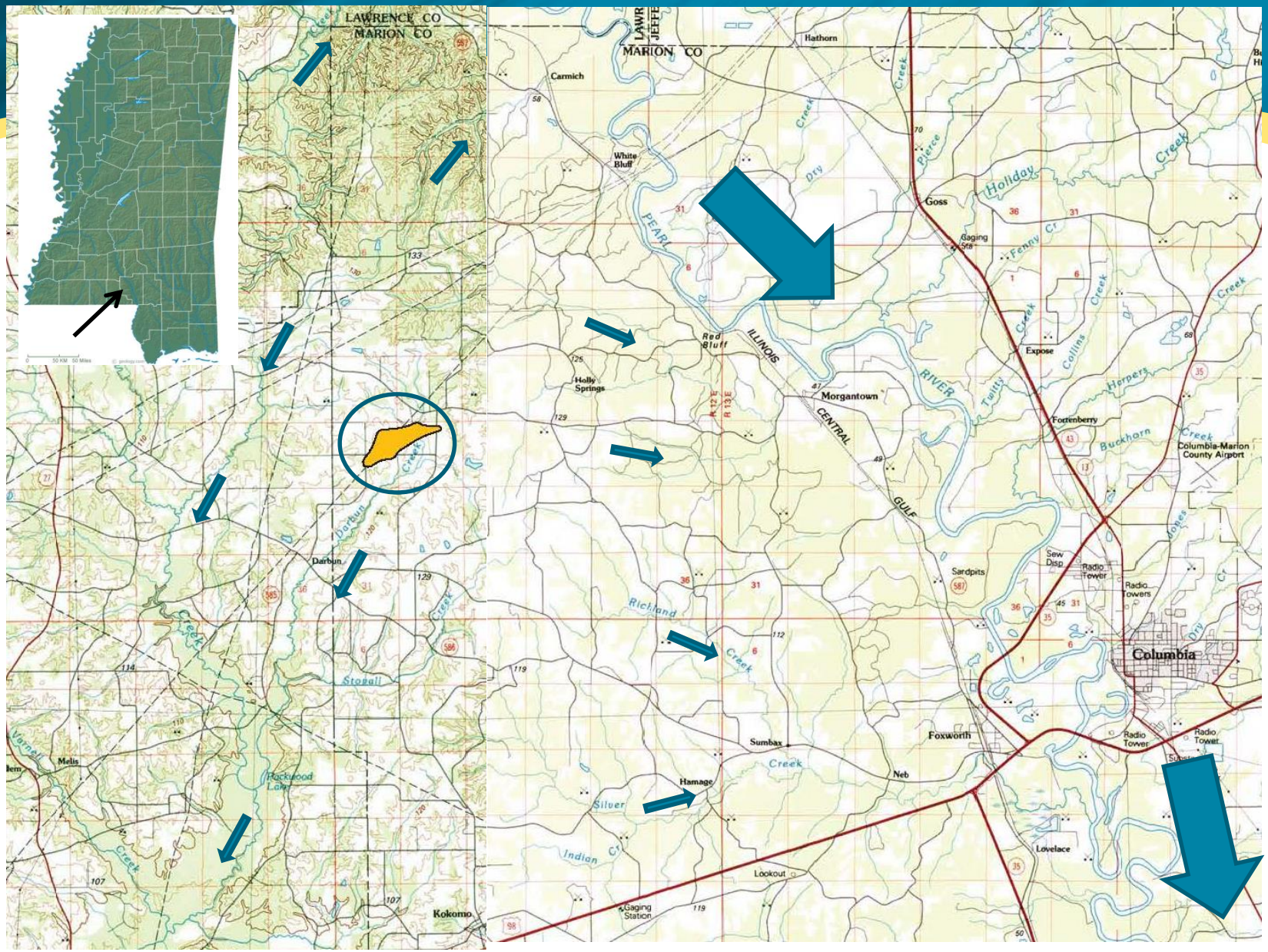
MWH®

BUILDING A BETTER WORLD

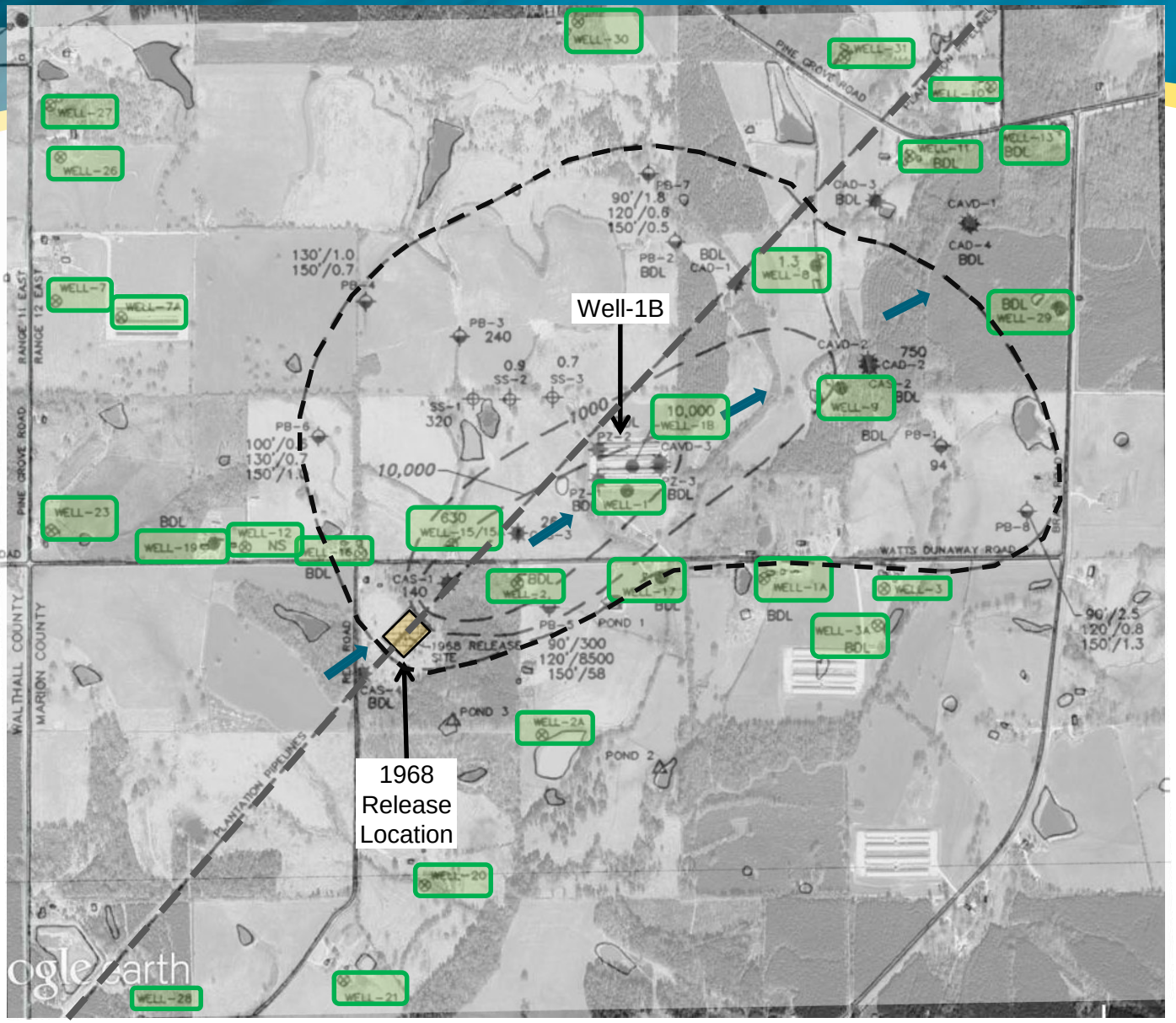
PRESENTATION OUTLINE

- Summary of Key Assessment Results
- Lithology and Hydrogeology
- Nearby Receptors
- Biodegradation Processes
- F&T Modeling Predictions
- Long-Term Monitoring Program
- Long-Term Monitoring Results vs F&T Predictions
- Unexpected and Unforeseen
- Lessons Learned

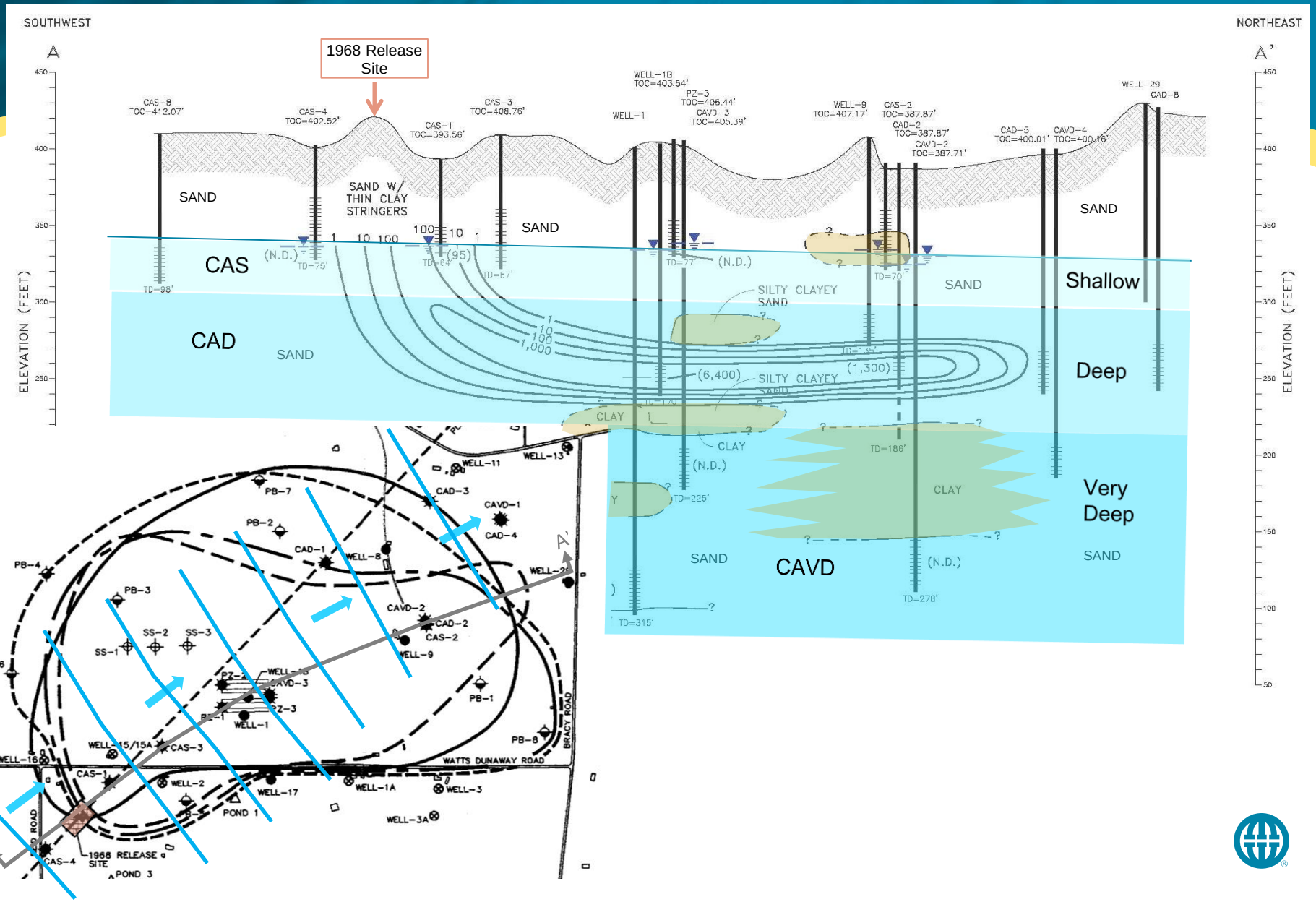
SITE LOCATION & TOPOGRAPHY



RELEASE HISTORY & RECEPTORS

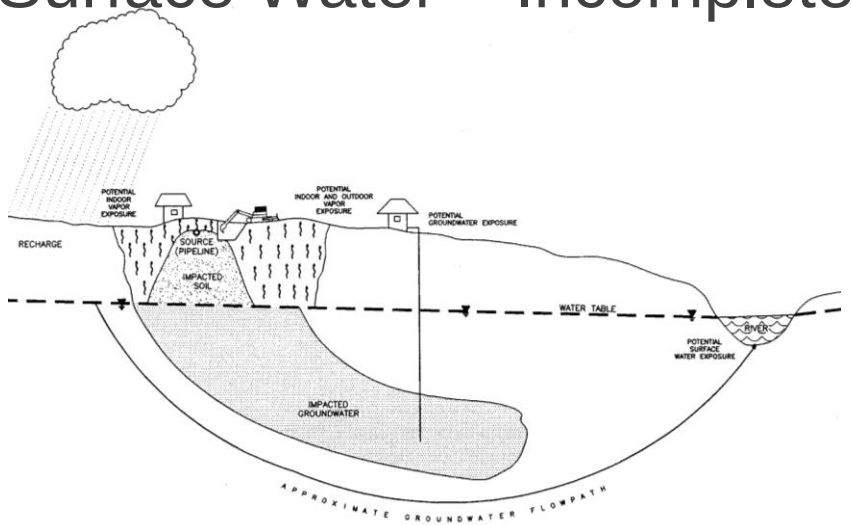


HYDROGEOLOGY & PLUME BEHAVIOR



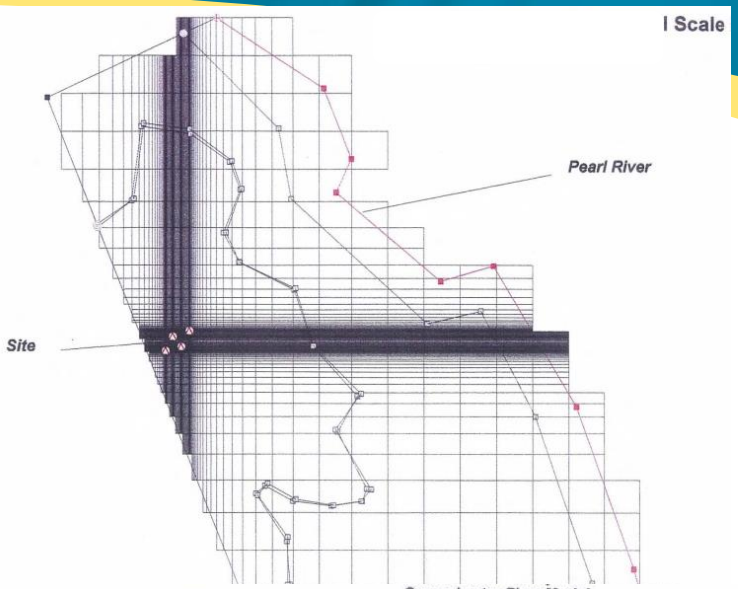
POTENTIAL EXPOSURE PATHWAYS

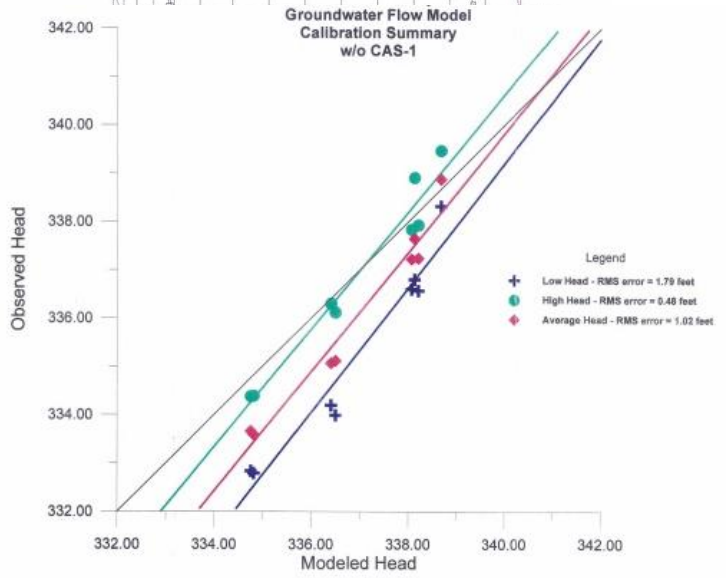
- Direct Contact – Incomplete (below grade release)
- Excavation near Release – Potentially Complete
- Vapor Intrusion – Incomplete (Soil Vapor Survey)
- Ingestion of Groundwater – Incomplete (water-supply wells in area replaced with Municipal Water Supply)
- Groundwater to Surface Water – Incomplete (GW is 50 to 65 feet bgs)



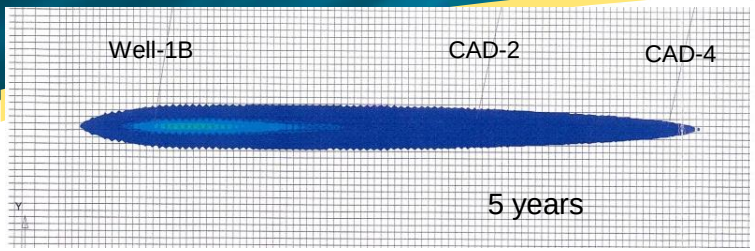
FATE & TRANSPORT MODELING

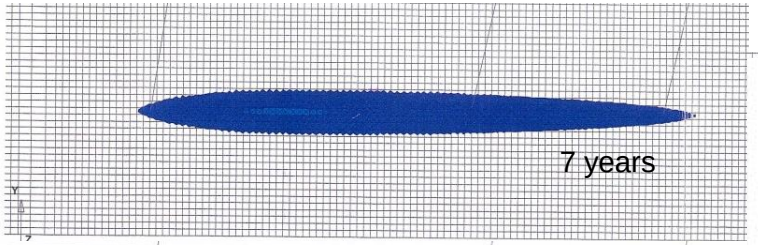
- Modflow for GW flow modeling
- RT3D and MT3D for benzene
- K = 160 to 250 ft/day
- Porosity = 20%
- Vx_{GW} = 250 to 500 ft/year
- Flow towards Pearl River
- 50ft by 150ft Source @ 60mg/L
- Dispersion X=10ft, Y=0.1ft, Z=0.01ft
- Minimal Retardation
- Recharge of 19 in/year

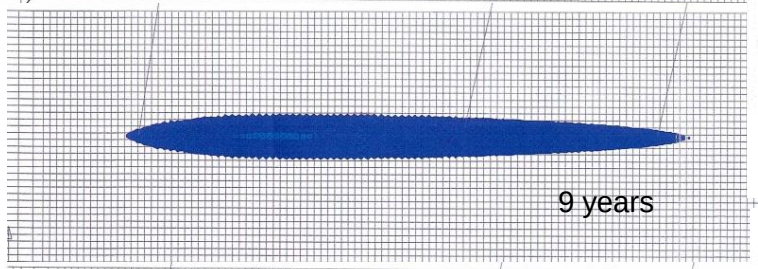


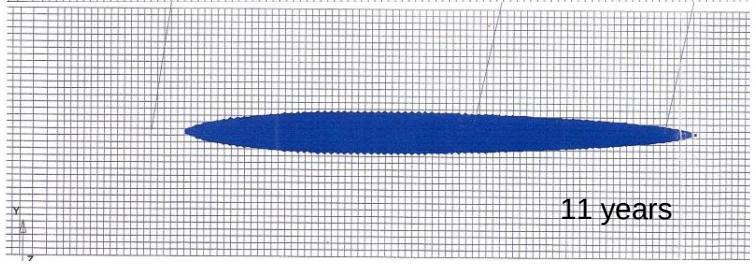


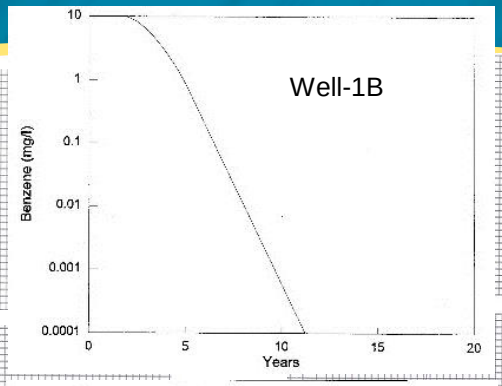
FATE & TRANSPORT MODELING RESULTS

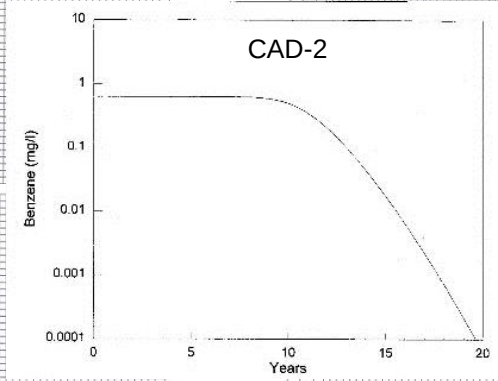


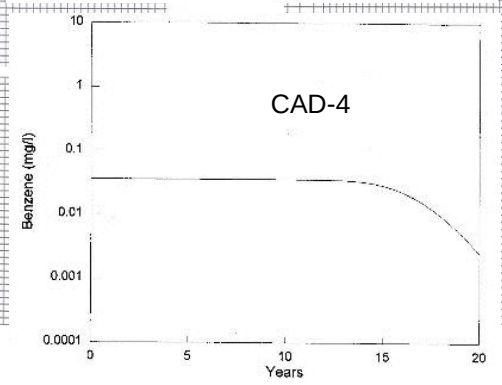


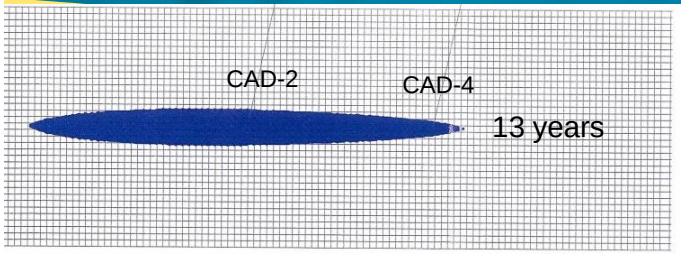


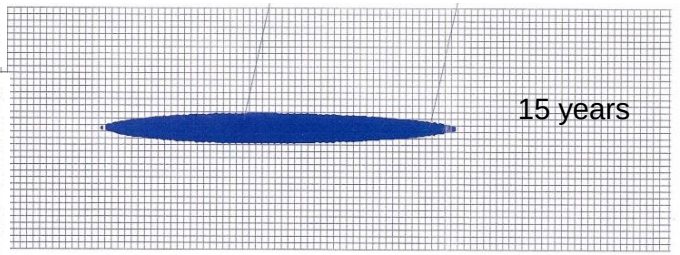


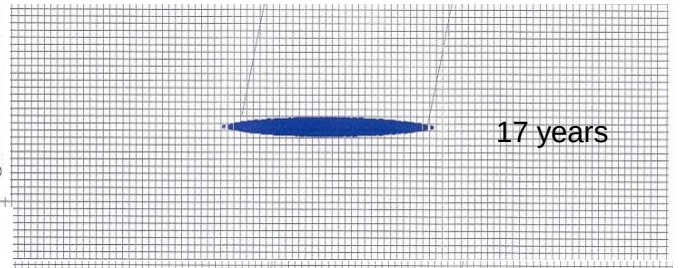


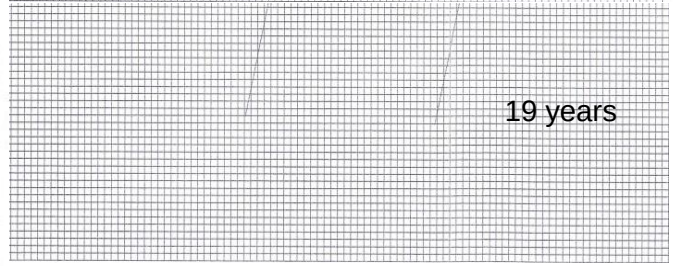












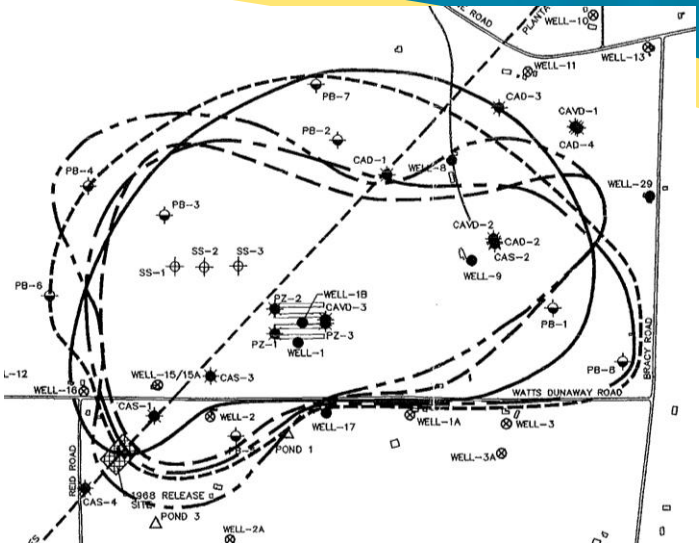
TECHNOLOGY REVIEW

OPTION: / CRITERIA	FULL PLUME COVERAGE	DOWN-GRADIENT CONTAINMENT	MNA
Reliability	Moderate to Good	Moderate to Good	Very Reliable once degradation starts
Reduce Mobility, Toxicity, Volume	Good reduction of Mass & Toxicity in groundwater	Good in treatment area, none in up-gradient area	Complete reduction of toxicity and volume
Short-Term Effectiveness	Moderate to good, expect rapid initial reductions	Good in treatment areas, poor in up-gradient area	Effective only for stable plumes
Implementability	Difficult to implement due to #of wells, moderate operational reliability	Difficult to implement due to number of wells, good operational reliability	Easy to implement, limited #of wells
Responsive to Community	Very intrusive, 800 to 1,000 wells over 400 acres	Very intrusive, 40 to 100 wells over 80 acres	Relatively Non-Intrusive
Responsive to State & EPA	Mechanical systems widely accepted, EA is new	Mechanical systems widely accepted, EA is new	If Plume is Stable, MNA is acceptable
Relative Cost	Very High	High	Moderate
Anticipated Duration	12 to 15 years	15 to 20 years	20 to 25 years

TECHNOLOGY SELECTION

Selected MNA Based on:

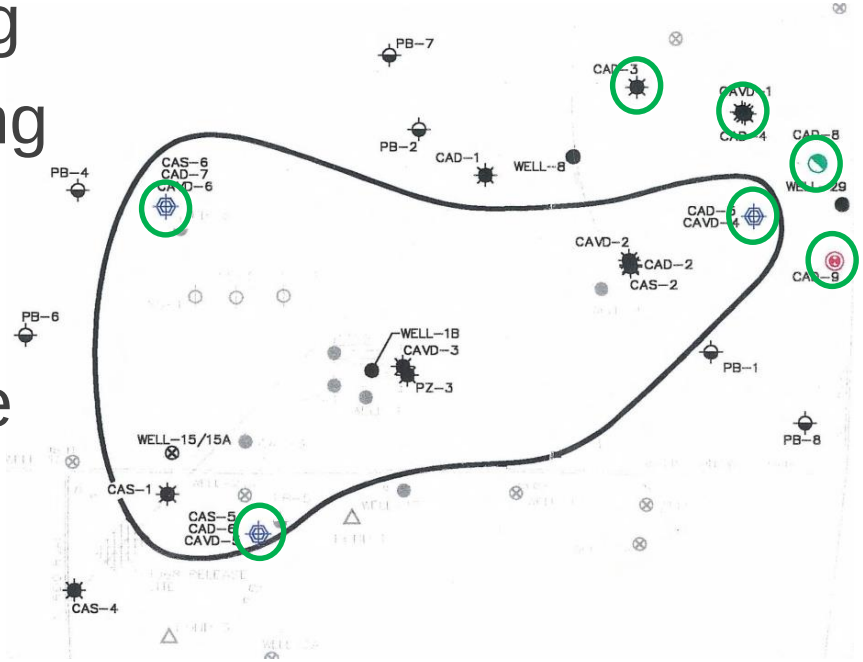
- No Potential Receptors in area of Plume (private wells are inactive)
- Plume appears to be Stable
- Timeframe to achieve Remedial Goals is similar for Containment & MNA



- MNA is less invasive than Containment or Full Scale Options
- Groundwater use restrictions can be implemented to prevent future use of impacted groundwater
- Contingent Remedy can be Implemented if plume begins to migrate and threaten potential receptors

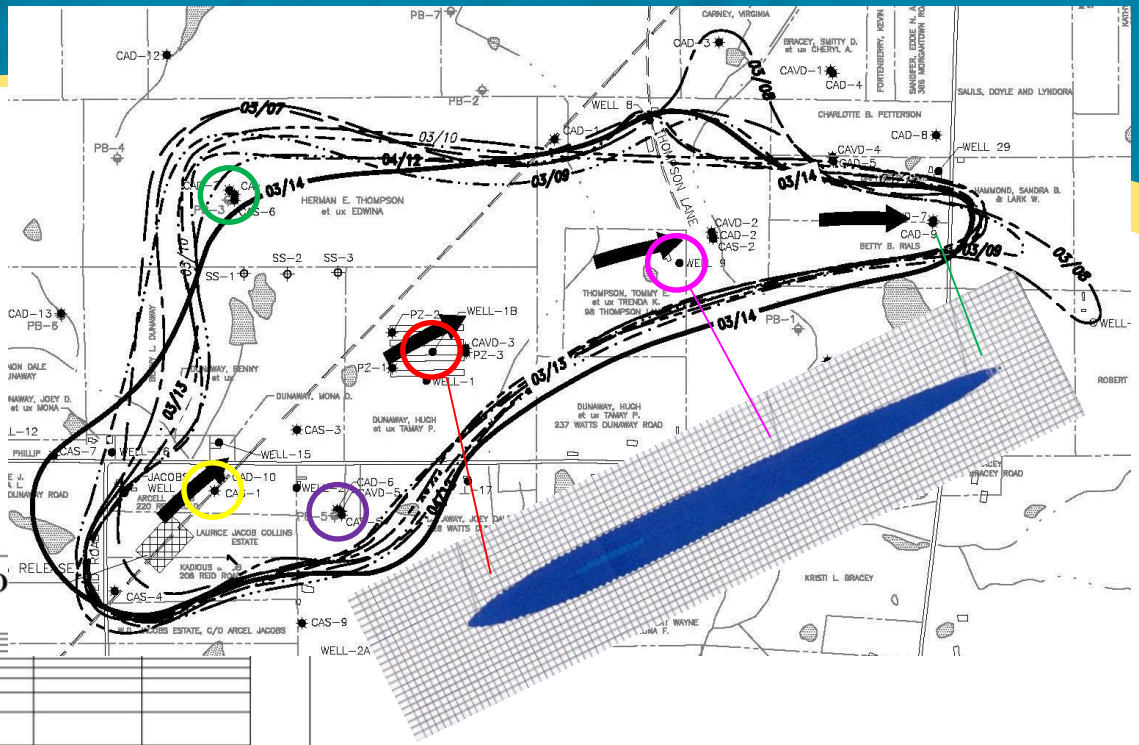
LONG-TERM MONITORING PLAN

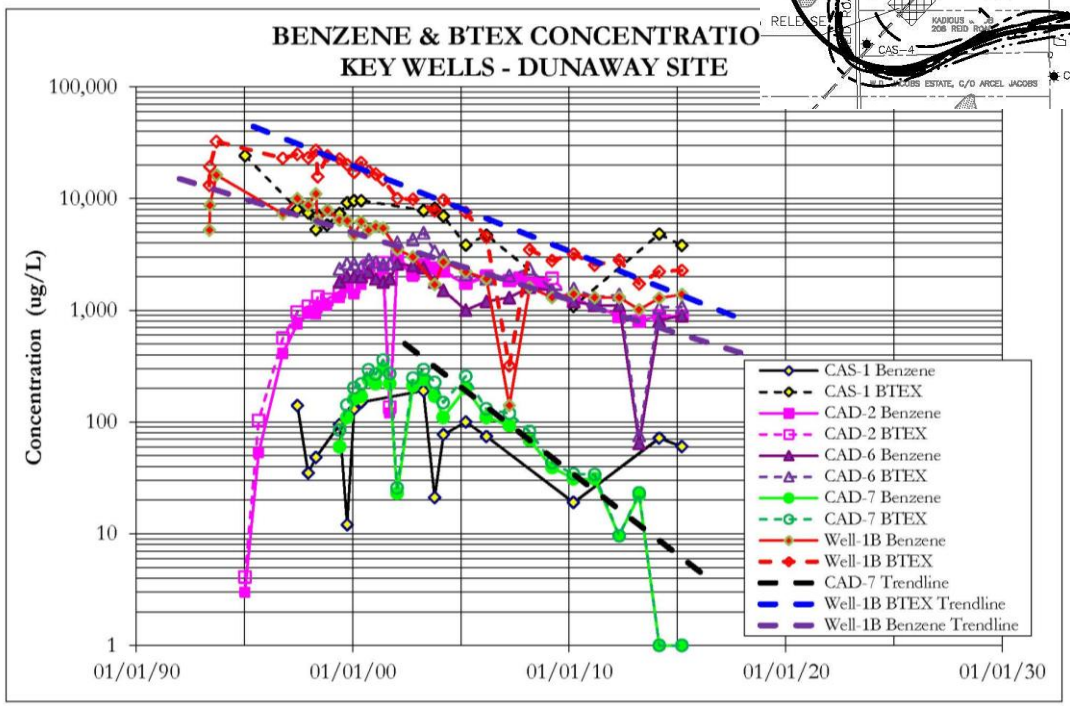
- Sample 31 wells per event
- Three Years Triannual Sampling
- Two Years Semiannual Sampling
- Five Years Annual Sampling
- Annual Sampling Point of Compliance wells (O) to closure
- Biennial Sampling of up and cross-gradient Wells to closure
- Low-Flow Purging techniques
- Monitoring Program Began in May 1999



LONG-TERM MONITORING RESULTS

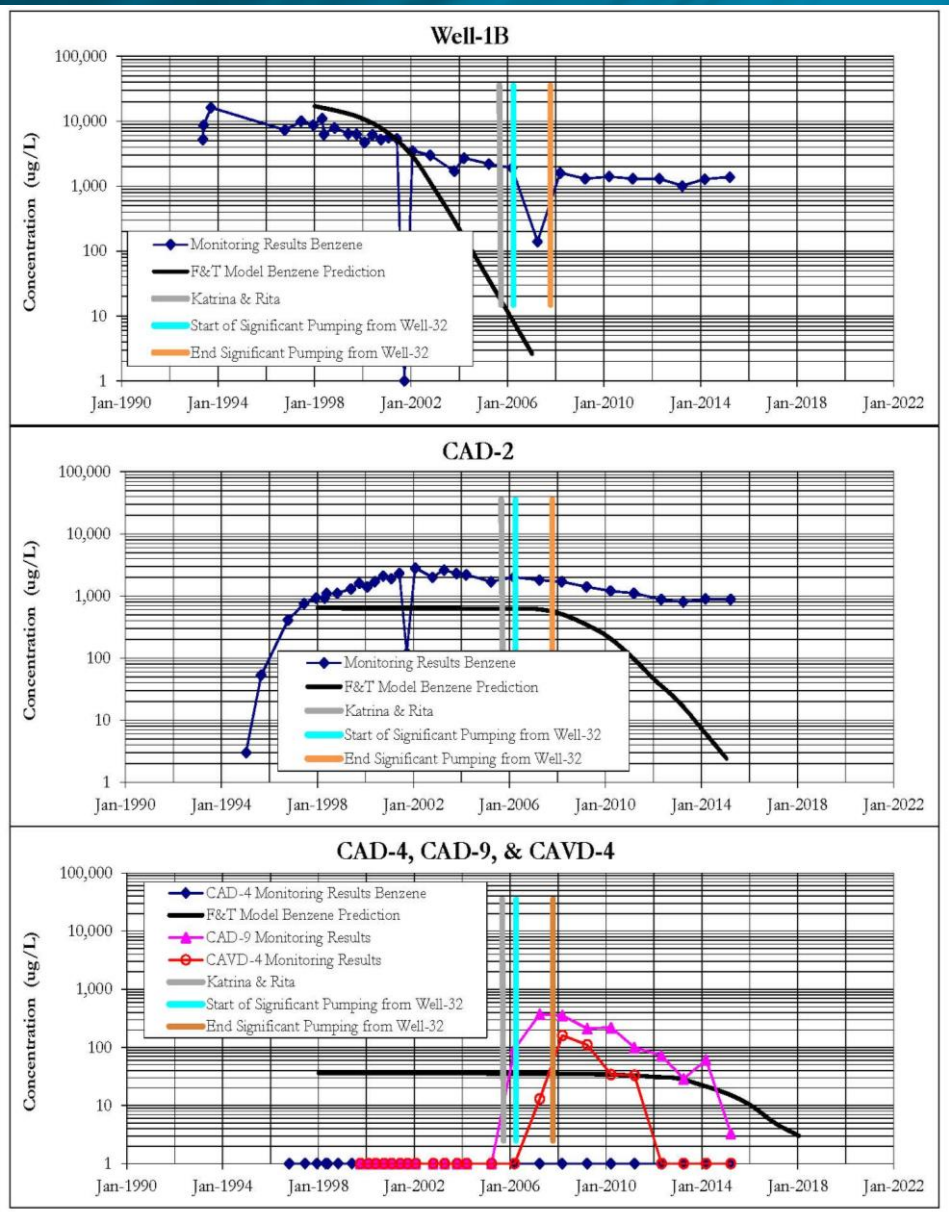
- Stable Plume
- Exponential Decay
- Actual Plume is larger than predicted



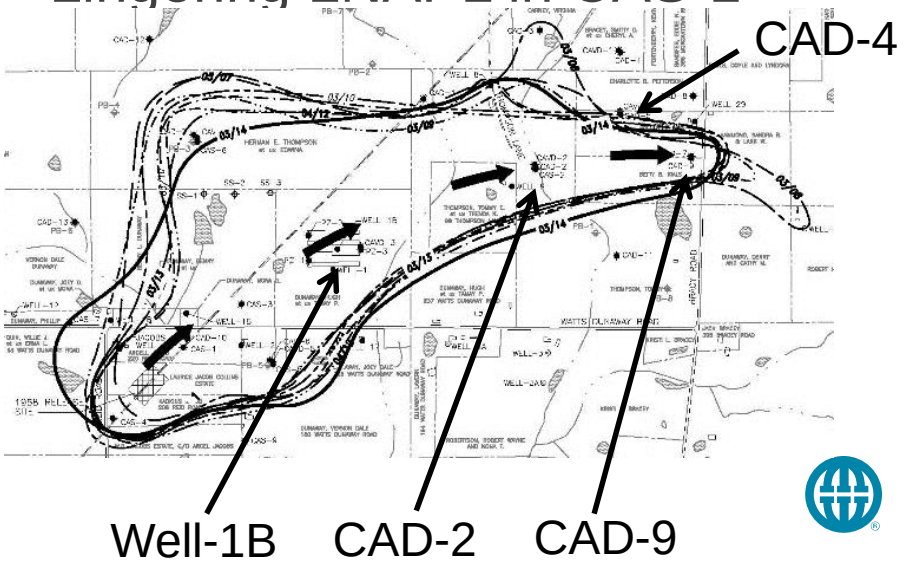


- Degradation is faster down & cross-gradient
- Larger source than assumed for model??

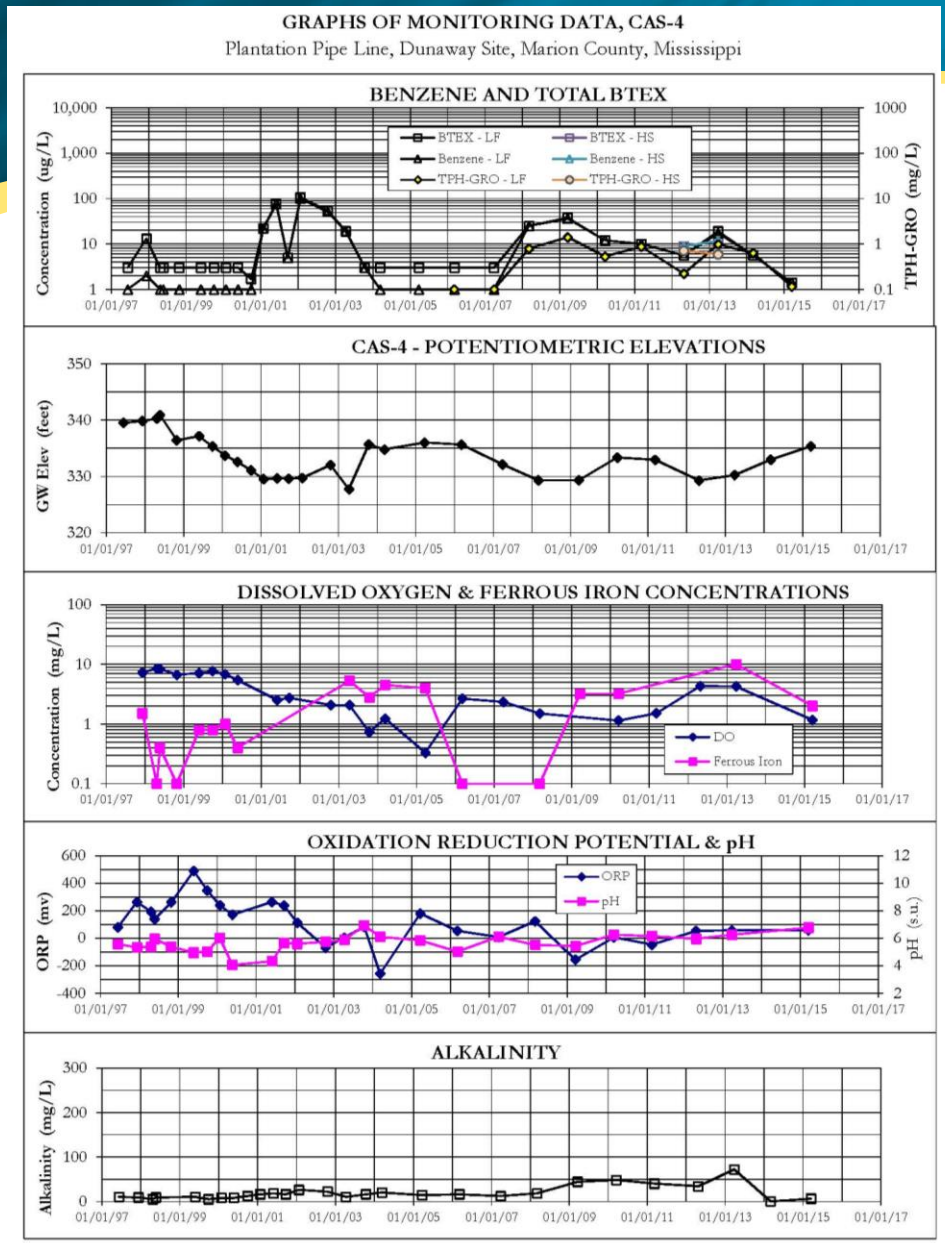
LONG-TERM MONITORING RESULTS vs F&T MODEL PREDICTIONS



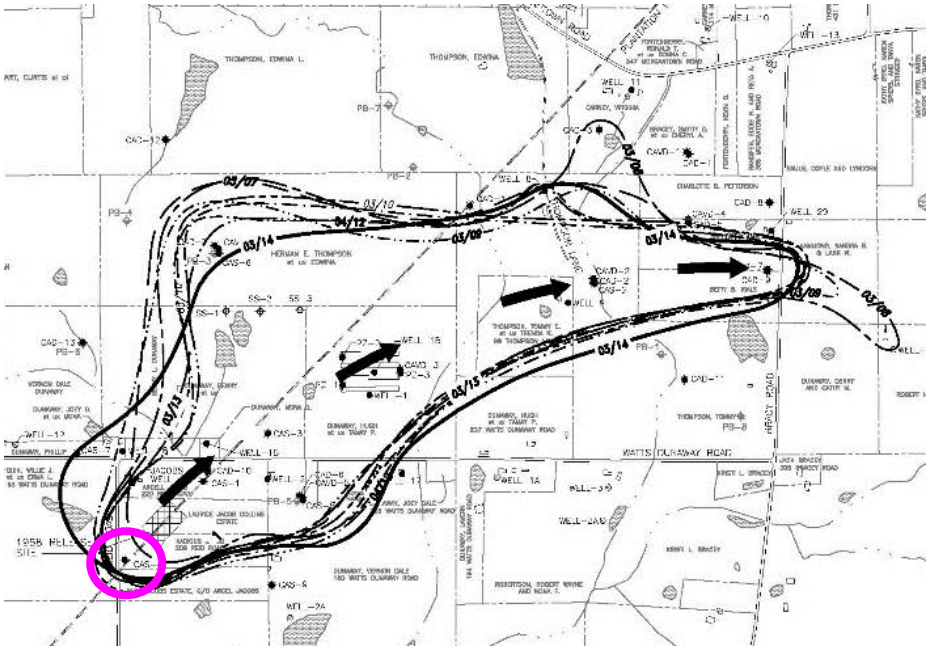
- Benzene decay in Well-1B & CAD-2 is slower than predicted
- Model assumed CAD-4 is on Primary Flowpath (it is not)
- CAD-9 & CAVD-4 similar to model predictions for CAD-4
- Lingering LNAPL in CAS-1



PLUME PERIMETER FLUCTUATIONS



- Up-gradient CAS well
- GW Drainage Divide
- Detects during GW low
- BDL during GW high



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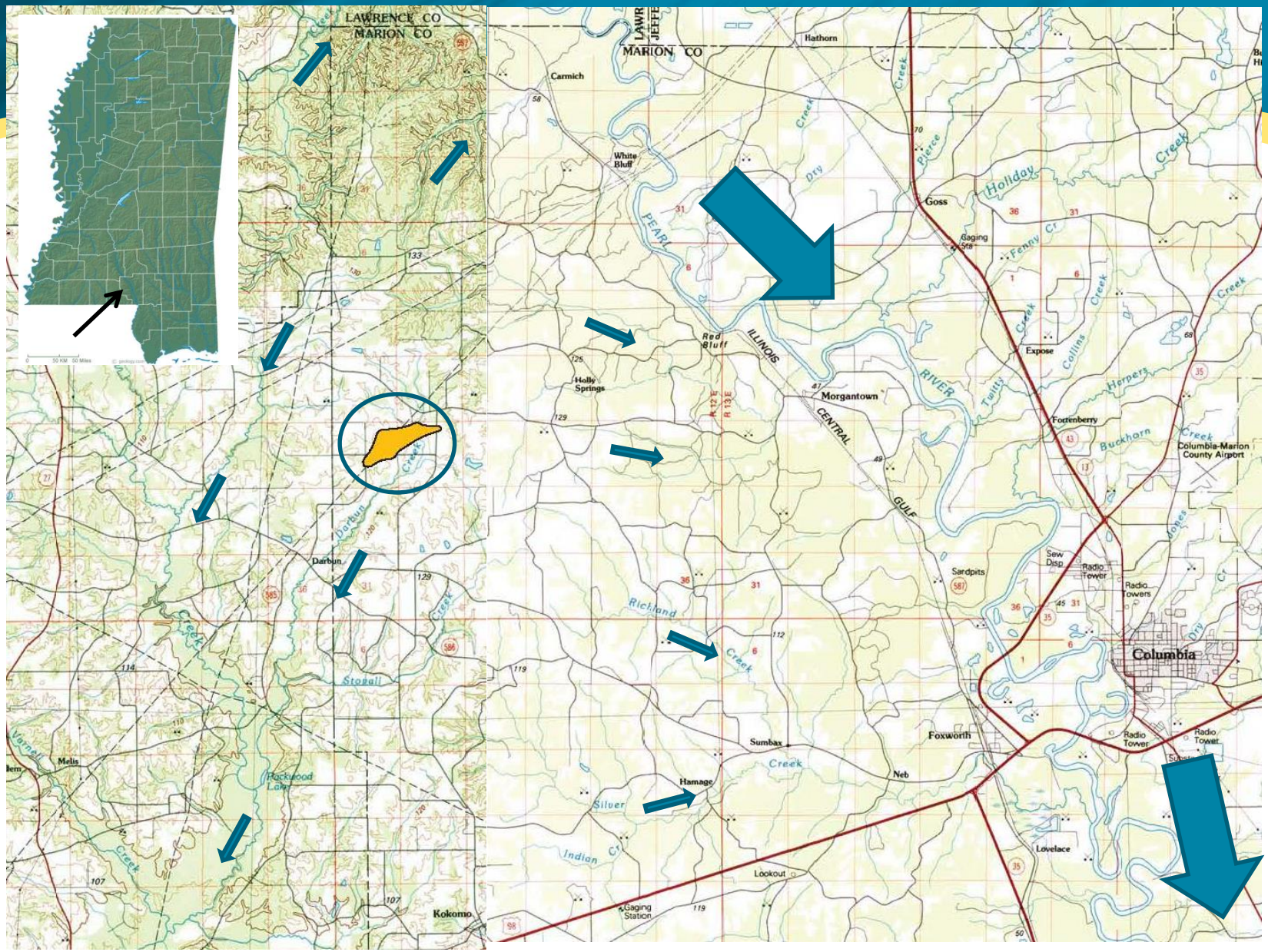

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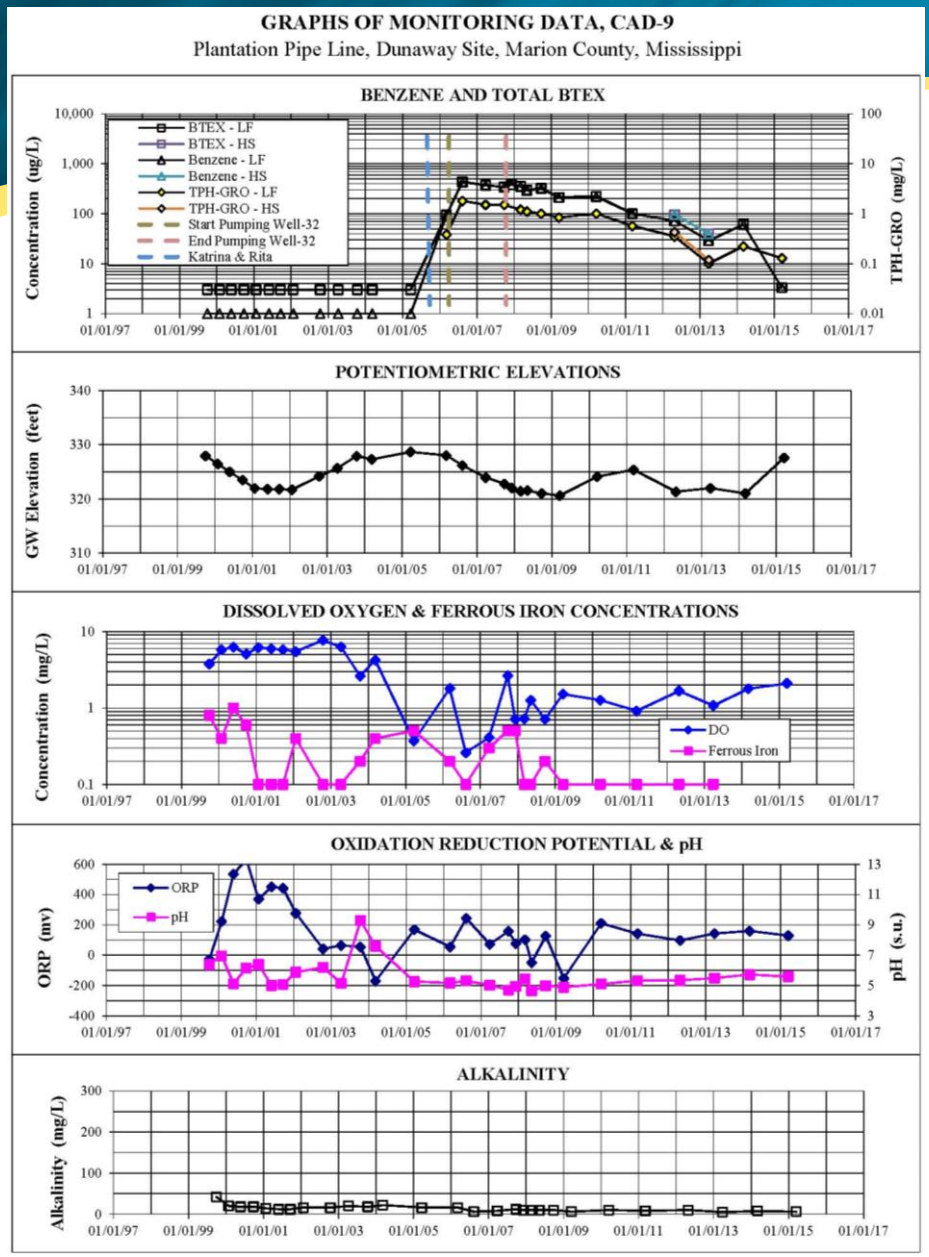
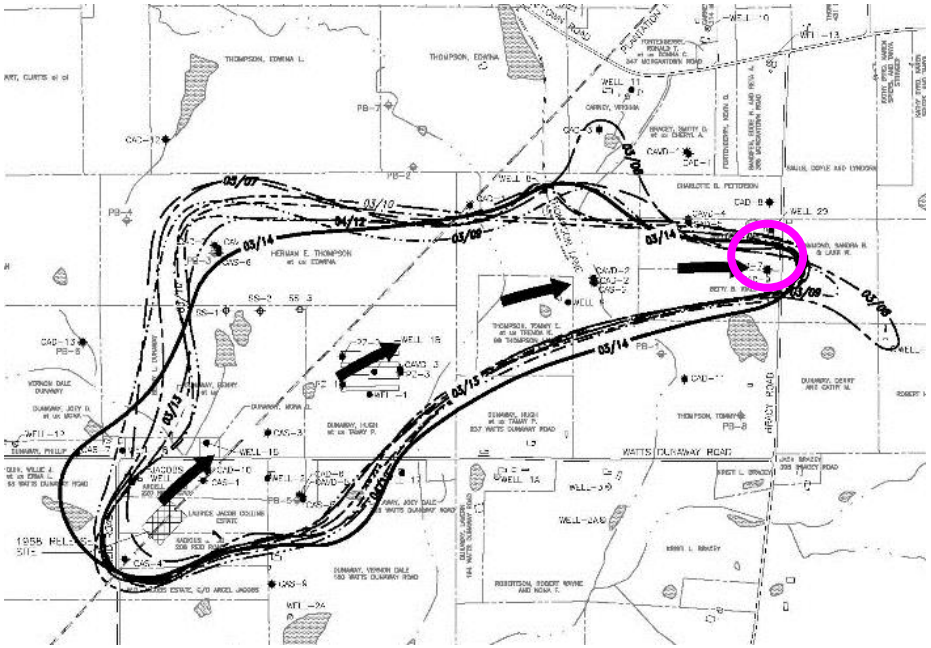


- Down-gradient CAD well
- Detects after Katrina-Rita & pumping from nearby water-supply well (0.75-mile SE)
- Fluctuation is dissipating



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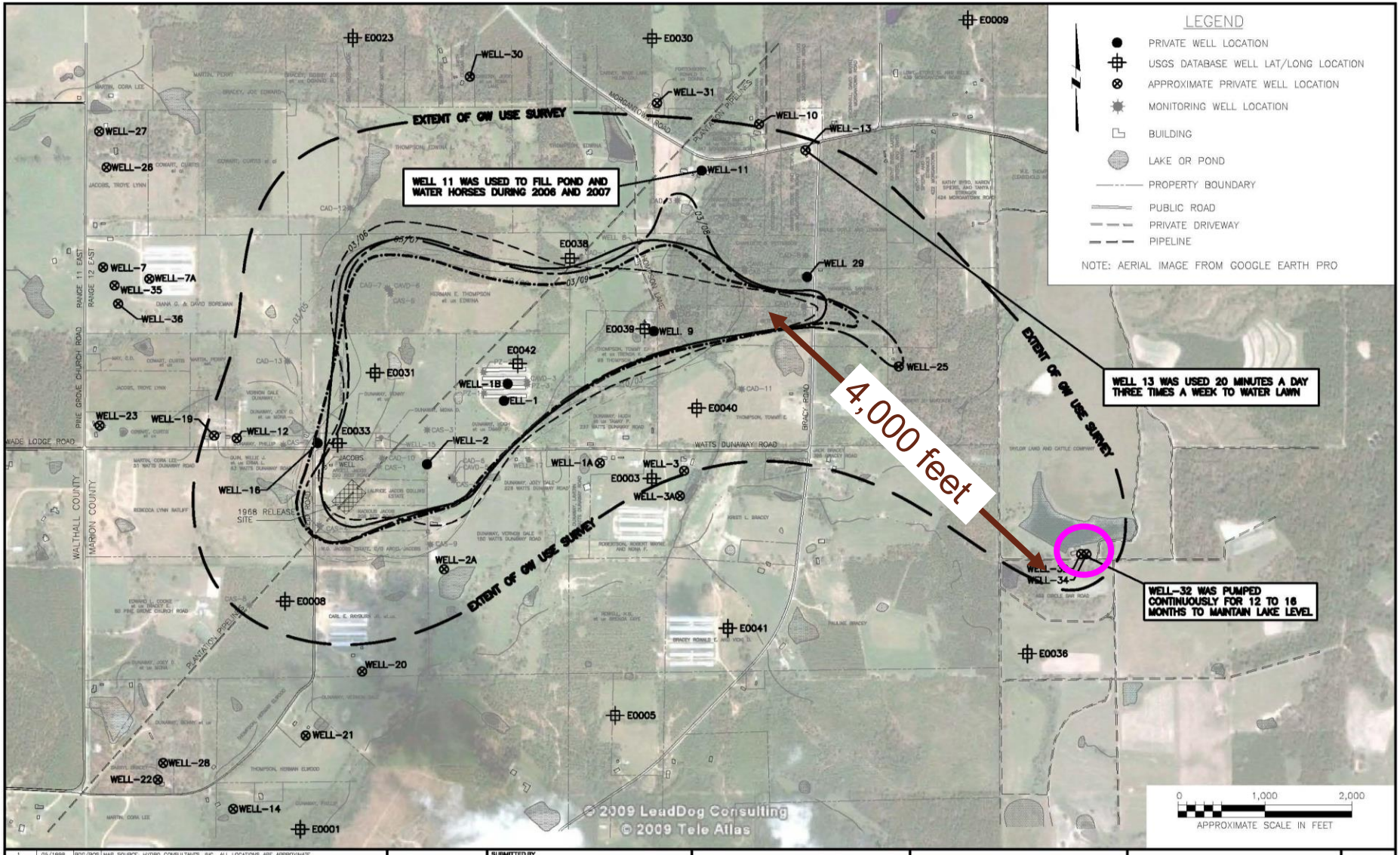

REV	DATE	BY	DESCRIPTION
1	03/1999	BDG/ROS	MAP SOURCE, HYDRO CONSULTANTS, INC., ALL LOCATIONS ARE APPROXIMATE
2	03/2009	BDG/BCC	EXTENDED MAP AREA 3,000 FEET EAST USING GOOGLE EARTH PRO AERIAL IMAGERY, FIELD RECONSISSANCE, AND PROPERTY OWNER INFORMATION FROM FOXWORTH AND SHEPARD, P.A.
3	05/26/09	BDL/BCC	ADDED DATA FOR GROUNDWATER USE UPDATE

DESIGNED BENJAMIN D. GROVE
DRAWN BRANDON C. COLEMAN
CHECKED

SUBMITTED BY
BENJAMIN D. GROVE (PROJECT MANAGER'S NAME) LICENSE NO. DATE
(COMPANY OFFICER'S NAME) LICENSE NO. DATE

MWH

PLANTATION PIPE LINE
DUNAWAY SITE
MARION COUNTY, MISSISSIPPI

GROUNDWATER USE SURVEY RESULTS
MARCH 2009

FIGURE 11

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PRINT DATE/TIME 7/28/2009 2:54 PM

UNEXPECTED & UNFORESEEN

- Regulatory Changes
  - Five Regulatory PMs in 15 years
  - Negotiated Minimum Purge Volumes
  - Negotiated No Gauging while Purging
  - MDEQ Added TPH-GRO to COC list
  - MDEQ Added wells to Sampling list

2. The purge volume was inadequate for all of the wells. Although there is no minimum well volume associated with the low-flow/low stress technique, it is MDEQ policy that at least 1 well volume be withdrawn prior to sampling. Most of the wells at this site were purged between **1% and 10% of one** well volume.

3. Water level measurements should be collected at set time intervals during a low-flow/low stress purging, per the U.S. EPA Environmental Investigations SOP's Section 7.2.2. No water level measurements, other than the initial measurement, were collected and/or reported.

2. In February of 2002, the MDEQ added total petroleum hydrocarbons, gasoline range organics (TPH, GRO) to its Tier I Target Remediation Goal Table. Therefore, TPH (GRO) shall be added to the list of compounds for analysis at this site.

1. Before MDEQ determines if Hydrasleeve sampling is a viable option, MDEQ requests that MHW conduct an intermediate sampling event to compare the low-flow and Hydrasleeve data on the following wells: CAS-4, CAD-6, CAD-9, and Well-1B.

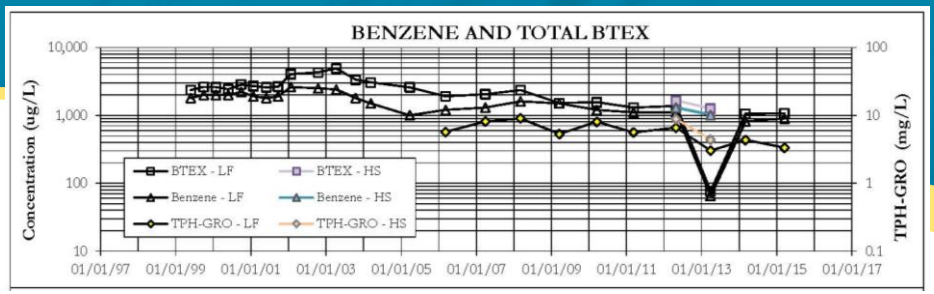
2. MDEQ requires that plume maps for each constituent of concern, not just a BTEX plume map, be including in monitoring reports.

3. MDEQ requires that report tables include columns for each constituent of concern. Please include columns for toluene, ethylbenzene, and xylenes in Table 4.

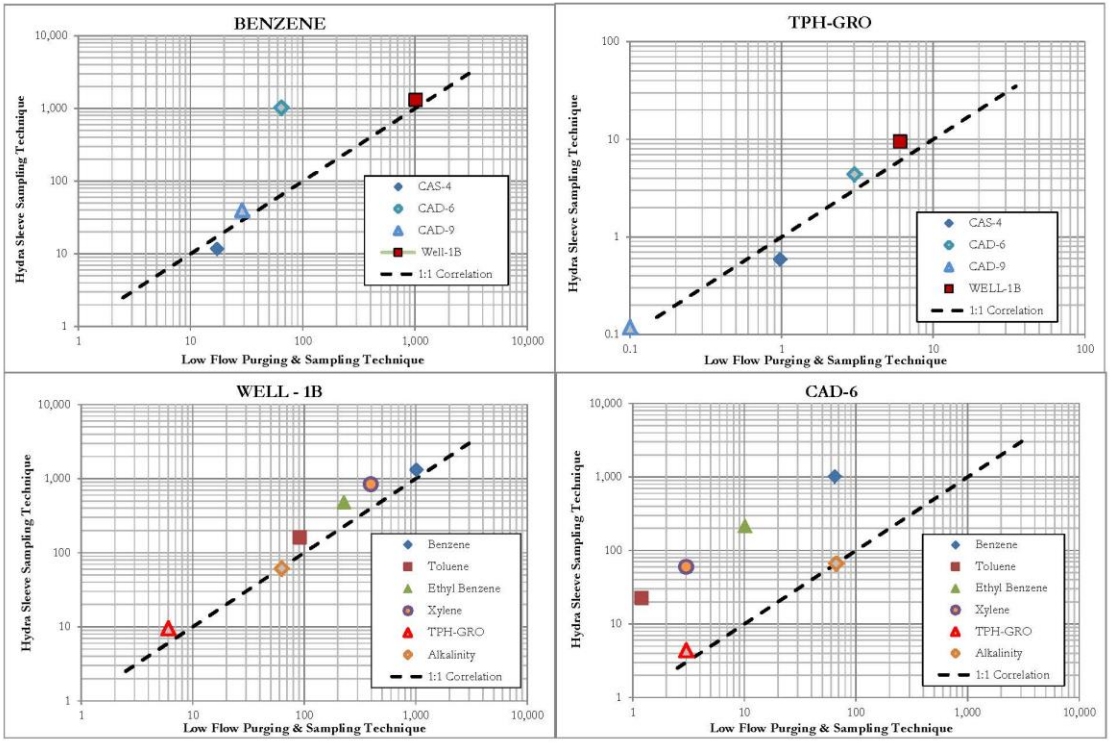
4. MDEQ requests that table units remain consistent. In Table 4 and Table 7, GRO concentrations should be in mg/L, not µg/L.

5. MDEQ requests that MHW purge three (3) tubing volumes instead of one (1) tubing volume for the next sampling event.

UNEXPECTED & UNFORESEEN



- Technical Changes
  - Changed Purge & Sample Techniques
  - Lab Personnel, Location, or Techniques



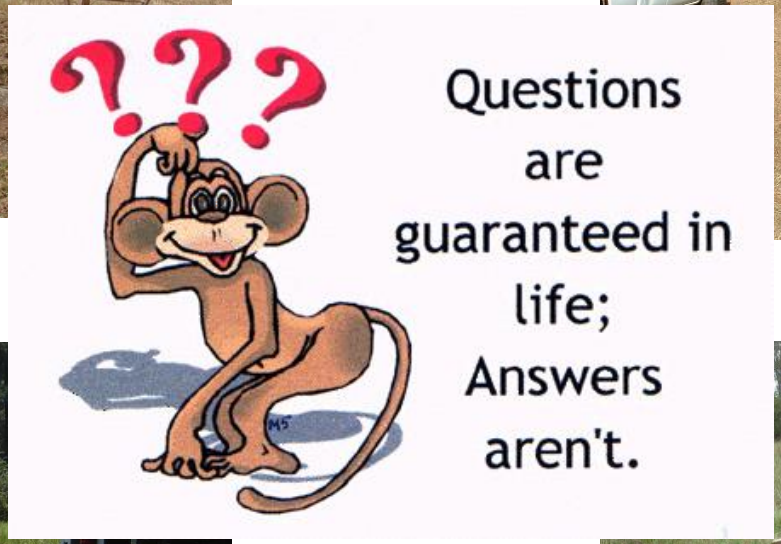
UNEXPECTED & UNFORESEEN

- Property Use Changes
  - Comply with GW use Restrictions
  - Access to Monitoring Wells
  - Well Repair or Replacement
  - Road & Culvert Repairs

LESSONS LEARNED

- Document, Document, Document, and Document
- Plan and budget for well maintenance
- Perform GW Use Surveys at routine intervals
- Observe onsite and nearby property use
- Understand Regulations, be aware of pending changes
- Be ready to adjust monitoring program
- Perform side by side sampling before changing anything
- Look for effects causing perimeter plume fluctuations

QUESTIONS?


Questions
are
guaranteed in
life;
Answers
aren't.


NEW HOLLAND